



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited A++ Grade by NAAC | 12B Status by UGC | Approved by AICTE

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SCHOOL OF COMPUTING

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

1.1.3 Courses having focus on employability/ entrepreneurship/ skill development

B.E Computer Science and Engineering With Specialization In Artificial Intelligence and Robotics			
Employability			
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Skill Development			
	SCSA2508	Robotic Programming using python Lab	10
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Entrepreneurship			
	S612APT1	Professional Training - I	
	S612AIPROJ	Interdisciplinary Project	

SCSA1515	INTELLIGENCE OF BIOLOGICAL SYSTEM	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand basics of cell biology.
- To learn the basic cellular energy production & cell cycle.
- To get the deep insight of meiosis, gametes and expression of gene.
- To understand about the cellular signal transduction and conversion of energy.
- To investigate the process of DNA replication.
- To understand the application of python to solve bioinformatics issues.

UNIT1 CLASSIFICATION OF MICROMOLECULES AND CELLULAR STRUCTURES 9Hrs.

Composition of Biomolecules, Nucleotide Structure, Protein Structure and Function, Lipid Structure and Function, Carbohydrate Structure and Function, Cell Theory, Prokaryotic Cells, Eukaryotic Cells.

UNIT2 CELLULAR ENERGY PRODUCTION AND UTILIZATION, CELL CYCLE AND DIVISION 9Hrs.

Biochemical Reactions, Enzymes, Photosynthesis, Aerobic Cellular Respiration, Anaerobic Respiration, Cell Stages, Maintenance of Ploidy, Interphase, Mitosis, Other Methods of Cellular Replication

UNIT3 MEIOSIS, GAMETES FORMATION, GENE- EXPRESSION, EVOLUTION 9Hrs.

Meiotic Process, Meiosis-I,II, Genetic diversity as a result of Meiosis, Genes, Structure, Transcription in Prokaryotic Organisms, Eukaryotic Transcription, Translation, Mutation, Genetic engineering and recombinant DNA technology, Descent with modification, Result of natural selection, Factors in Evolution, Speciation and Phylogeny

UNIT4 CELLULAR SIGNAL TRANSDUCTION AND ENERGY CONVERSION 9Hrs.

Cellular Signaling, Receptor Binding, Signal Transduction via Nuclear receptor, Signaling in Apoptosis, Metabolism and ATP, Anaerobic cellular respiration, Aerobic respiration, Photosynthesis, Carbohydrate synthesis. .

UNIT5 DNA REPLICATION & MOTIFS 9Hrs.

DNA replication – genome - hidden messages in the genome - Python Programming and packages for Bioinformatics - Finding Replication Origins - DNA boxes - Counting words - The Frequent Words Problem - Frequent words in Vibrio cholera – encodings in DNA to maintain circadian rhythm – Hunting for Regulatory Motifs - Motif Finding - Scoring Motifs - Greedy Motif Search - Randomized Motif Search - Gibbs Sampling

Max. 45 Hrs.

COURSE OUTCOMES

CO1-Understand the cell biology basics.

CO2-Ability to get the deep insight of cellular energy production and the stages of cell cycle.

CO3-Explain the meiosis, gametes and expression of gene.

CO4- Describe the cellular signal transduction and energy conversion.

CO5-Ability to realize the DNA replication process,

CO6-Apply the features of python to solve the various issues in bio informatics.

TEXT /REFERENCE BOOKS

1. Ryan Rogers, “Cell and Molecular Biology for Environmental Engineers”, Momentum Press Engineering, 2018.
2. Gabi Nindle Waite, Lee R Waite, “Applied Cell and Molecular Biology for Engineers”, The McGraw-Hill Companies, 2007.
3. Phillip Compeau & Pavel Pevzner, “Finding Hidden Messages in DNA”, Active Learning Publishers, 2015.

SCSA1516	SIGNAL AND IMAGE PROCESSING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the basic concepts of signal and Image processing.
- To explore DFT for 1-D and 2-D signal
- To understand fundamentals of Image Processing
- To provide knowledge of the applications of the theories taught in Image Processing
- To apply digital image processing techniques for edge detection.
- To design and implement 1-D and 2-D Signal and Image Processing applications.

UNIT1 INTRODUCTION TO SIGNAL PROCESSING

9Hrs.

Introduction to Digital Signal Processing- Sampling and Reconstruction-Standard DT Signals-Concept of Digital Frequency-Representation of DT signal using Standard DT Signals-Signal Manipulations:shifting, reversal, scaling, addition, multiplication-Classification of Discrete-Time Signals-Classification of Discrete Systems.

UNIT2 DISCRETE-TIME SIGNAL SYSTEM

9Hrs.

Linear Convolution formulation for 1-D and 2-D signal (without mathematical proof), Circular Convolution (without mathematical proof), Linear convolution using Circular Convolution. Auto and Cross Correlation formula evaluation, LTI system, Concept of Impulse Response and Step Response, Output of DT system using Time Domain Linear Convolution- Introduction to DFT-Properties of DFT- DFT computation using DFT properties

UNIT3 INTRODUCTION TO IMAGE PROCESSING

9Hrs.

Image formation, image geometry perspective and other transformation, stereo imaging elements of visual perception-Digital Image-sampling and quantization serial & parallel Image processing.

UNIT4 IMAGE RESTORATION

9Hrs.

Image Restoration-Constrained and unconstrained restoration Wiener filter , motion blur remover, geometric and radiometric correction Image data compression-Huffman and other codes transform compression, predictive compression two tone Image compression, block coding, run length coding, and contour coding.

UNIT5 SEGMENTATION TECHNIQUES

9Hrs.

Segmentation Techniques-thresh holding approaches, region growing, relaxation, line and edge detection approaches, edge linking, supervised and unsupervised classification techniques, remotely sensed image analysis and applications, Shape Analysis – Gestalt principles, shape number, moment Fourier and other shape descriptors, Skelton detection, Hough trans-form, topological and texture analysis, shape matching.

Max. 45 Hrs.

COURSE OUTCOMES

CO1-Understand the concept of DT Signal and DT Systems

CO2-Classify and analyze discrete time signals and systems

CO3-understand Basics of Image formation and transformation using sampling and quantization

CO4-Design and develop the enhancement techniques for digital Image Processing

Co5-To apply digital image processing techniques for edge detection.

CO5-Develop small projects of 1-D and 2-D Signal and Image Processing

TEXT /REFERENCE BOOKS

1. Sanjit Mitra, 'Digital Signal Processing: A Computer Based Approach', TataMcGraw Hill, 3rd Edition.
2. S. Salivahanan, A. Vallavaraj, and C. Gnanapriya, 'Digital Signal Processing' Tata McGraw Hill Publication 1st Edition (2010).
3. A. Anand Kumar, 'Digital Signal Processing', PHI Learning Pvt. Ltd. 2013.
4. S. Jayaraman, E. Esakkirajan and T. Veerkumar, 'Digital Image Processing' TataMcGraw Hill Education Private Ltd, 2009.
5. Fundamental of Image Processing – Anil K.Jain, Prentice Hall of India

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Hrs.

Exam Duration : 3

PART A : 10 Questions of 2 marks each-No choice

20

Marks PART B :2 Questions from each unit with internal choice, each carrying 16 marks

80

Marks

SCSA2508	ROBOT PROGRAMMING USING PYTHON LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To implement the robotics using python.
- To understand the different operations in robotics using python.
- To learn to control the robot using python API.
- To get familiarized to pick the moving parts.
- To implement the python API to update and distance travelled in robotics.

LIST OF EXPERIMENTS

1. Program to add a robot to simulation world, add a python script behaviour to robot component, python script initialization, add statements, add motion statements using python API.
2. Program to add and edit routines, statements and positions in a robot program using Python API.
3. Program to manipulate the joints of a robot using its controller and DOF objects of nodes.
4. Program to teach a robot to pick parts from a pallet and place them on a conveyor using Python API.
5. Program to implement a robot to pick moving parts and then place them on other moving objects using python API
6. Program to Control and automate the robot using python API
7. Program to Check if a given sequence of moves for a robot is circular or not.
8. Program for Walking Robot Simulation in Python
9. Program to check robot can reach target by keep moving on visited spots in Python
10. Program to create a robot class that contains methods about movements and saving the movement instructions on a text file. A robot object can load the text file and execute the movements. A robot object finally gives the updated position and distance travelled.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1:** Remembering the concept of Python API for Robotics
- CO2:** Understand basic concepts to add a robot and initialize python script using python API
- CO3:** Able to apply and implement various robotic operations using python API
- CO4:** Ability to control and automate the robot using python.
- CO5:** Design and implement a robot to pick moving parts.
- CO6:** Develop a robot and teach to do different actions using python

SITA3007		L	T	P	Credits	Total Marks
	COMPUTATIONAL INTELLIGENCE	3	0	0	3	100

COURSE OBJECTIVES

- To know the scope of computational intelligence and the type of agents.
- To study the perceptron and learning techniques
- To explore the concept of fuzzy rules and systems
- To learn the steps in genetic algorithm
- To study the ant colony and swarm optimization algorithm

UNIT 1 ARTIFICIAL INTELLIGENCE

9 Hrs.

Introduction - Foundations of AI - History of AI - Intelligent agent - Types of agents - Structure - Problem solving agents - Uninformed and informed search strategies.

UNIT 2 ARTIFICIAL NEURAL NETWORKS

9 Hrs.

Basic concepts - Single layer Perceptron - Multilayer Perceptron - Supervised and Unsupervised learning -deep learning algorithms - Back propagation Networks - Performance Issues.

UNIT 3 FUZZY SYSTEMS

9 Hrs.

Introduction to fuzzy- Fuzzy sets and Fuzzy reasoning - Fuzzy matrices - Fuzzy Functions - Decomposition - Fuzzy rules and inferences - Fuzzy decision making - deep learning architecture for Fuzzy logic.

UNIT 4 GENETIC ALGORITHMS

9Hrs.

Survival of the fittest - Fitness Computations - Cross over- Mutation - Reproduction - Rank method - Rank Space method.

UNIT 5 SWARM INTELLIGENCE

9 Hrs.

Particle swarm optimization - Global PSO- Local PSO - Ant colony Optimization - Simple Ant Colony - Ant System - feature selection of logistic regression. - Max, Min Ant System.

Max. 45 Hours

COURSE OUTCOMES

On completion of the course the student will be able to

- CO1:** Understand the search strategies in AI
- CO2:** Analyse the performance issues of learning techniques
- CO3:** Solve a problem with fuzzy logic and rule out the inferences
- CO4:** Optimize continuous and discrete functions and multi objective problems
- CO5:** Design models for real world scenarios.
- CO6:** Design a case study and optimize the results

TEXT / REFERENCE BOOKS

1. Stuart Russel, Peter Norvig, "Artificial Intelligence A Modern Approach", 3rd Edition, Pearson Education, 2010
2. Elain Rich & Kevin Knight, Artificial Intelligence, Third edition, Tata McGraw Hill, 2010

SMRA1603	ROBOT PROGRAMMING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- ☐ To understand why Robot programming needed for programming a robot.
- ☐ To learn how Commands, Instructions in Robot programs.
- ☐ To understand how to provide Signal, Delay and Call functions in Robot Programming.
- ☐ To learn how to control a robot using offline programming.
- ☐ To design a robot program for controlling a industrial robot manipulator

UNIT1 INTRODUCTION TO ROBOT PROGRAMMING

9Hrs.

Robot software functions – coordinate systems - position control, other control functions, subroutines, Program planning for Robot flow charting for robot programs with few examples.

UNIT2 METHODS OF ROBOT PROGRAMMING

9Hrs.

Online programming, off-line programming, advantages of off-line programming, lead through methods - powered lead through, manual lead through, teach pendant, Robot program as a path in space, defining position in space, motion interpolation, WAIT, SIGNAL and DELAY commands, Branching capabilities and Limitations of head through methods.

UNIT3 ROBOT LANGUAGES

9Hrs.

Textual ROBOT Languages, first generation and second-generation languages, structure of a robot language - operating systems, Elements and Functions, constants, variables and other data objects, Motion commands, points in workspace, End effector and sensor commands, computations and operations, program control and subroutines, communications and Data processing.

UNIT4 VAL II

9Hrs.

General description, Monitor commands, motion command, Hand Control, Configuration control, interlock commands, INPUT/OUTPUT Controls, Program Control, examples.

UNIT5 AML

9Hrs.

General description, AML statements, Constant and variables, program control statements, motion commands, Sensor commands, Grip sensing capabilities, Data processing, examples

Max. 45 Hrs.

COURSE OUTCOMES

CO1-Describe the types of robot coordinate systems and programming functions.

CO2- Describing how to perform robot programming using online and offline method

CO3-Explain how to programming in various programming languages.

CO4-Design and develop robot programs with WAIT , SIGNAL and DELAY commands.

CO5-Ability to design robot program with interlock functions.

CO6-Apply the sensor feedbacks in robot programs.

TEXT /REFERENCE BOOKS

1. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey, 'Industrial Robotics Technology, Programming and Applications', Mc Graw Hill Book company, 1986
2. Bernard Hodges, 'Industrial Robotics', Second Edition, Jaico Publishing House, 1993

SCSA1612	MACHINE LEARNING FOR ROBOTICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Understand and implement the most popular learning algorithms.
- Perform feature selection and experimental set up on real tasks
- Analyze in detail about unsupervised learning, dimensionality concepts and neural networks.
- Evaluate multiple learning algorithms across several Robotic tasks

UNIT 1 INTRODUCTION

9Hrs.

Machine learning– Applications- Learning Input-Output functions: Types of learning–Input Vectors–Outputs– Supervised- Learning class from Examples – PAC- Unsupervised– Noise -BIAS AND VARIANCE - OCCAM'S RAZOR PRINCIPLE–Performance Evaluation.

UNIT 2 SUPERVISED LEARNING

9Hrs.

Decision trees and inductive bias–Geometry and nearest neighbors–Logistic regression–Perceptron Learning Boolean Functions –Binary classification.

UNIT3 ADVANCEDSUPERVISEDLEARNING

9Hrs.

Linear models and gradient descent–Support Vector machines–Naïve Bayes models and probabilistic modeling– Model selection and feature selection–Model Complexity and Regularization.

UNIT4 UNSUPERVISEDLEARNING

9 Hrs.

Curse of dimensionality, Dimensionality Reduction, PCA, Clustering–K-means–Expectation Maximization Algorithm – Mixtures of latent variable models – Supervised learning after clustering – Hierarchical clustering-Autonomous learning.

UNIT5 NEURALNETWORKS AND REINFORCEMENT LEARNING

9 Hrs.

Network Representation, Feed-forward Networks, back propagation, Model-Based Learning -Temporal Difference Learning.

ax. 45 Hrs.

COURSE OUTCOMES

- C01**-Define a model for your data and make the model learn.
- C02**-Build regression models to predict an unknown output from a given set of inputs.
- C03**-Create Machine Learning techniques to teach a robotic manipulator to move.
- C04**-Develop unsupervised and reinforcement models for various robotics tasks.
- C05**-Determine hidden parameters in data to improve the accuracy of your model's predictions.
- C06**-Create probabilistic data models to predict a range of possible outcomes that account for real-world robotic operation risks and uncertainties.

TEXT/ REFERENCE BOOKS:

1. Michalski, Carbonell, Tom Mitchell, 'Machine Learning', Springer, 2014.
2. Ethem Alpaydin, 'Introduction to Machine Learning', The MIT Press, 2004.
3. Peter Flach, 'Machine Learning: The Art and Science of Algorithms that make sense of data', Cambridge, 2014.
4. Hal Daume III, 'A Course in Machine Learning', Todo, 2015.
5. Bruno Apolloni, Ashish Ghosh, Ferda Alpasian, "Machine Learning and Robot Perception", Springer, 2005.
6. Judy Franklin, Tom Mitchell, Sebastian Thrun, "Recent Advances in Robot Learning: Machine Learning", Springer,

SCSA2609	NEURAL NETWORKS USING MATLAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To make students familiar with basic concepts and tools used in neural networks
- To understand students' structure of a neuron including biological and artificial
- To implement learning in network (Supervised and Unsupervised)
- To get familiarized the concepts of learning rules.
- To Use MATLAB to perform complex arithmetic

LIST OF EXPERIMENTS

1. Study of MATLAB
2. (a) Program to perform basic operations in MATLAB
(b) Program to perform matrix operations in MATLAB
3. Program to calculate the factorial of a number by creating a script file by using while loop
4. Program to plot the straight line and sine curve
5. program in MATLAB to find the factorial by creating a function file by using for loop
6. Program to draw a graph with multiple curve
7. Program to plot Activation function used in neural network
8. Program to plot piecewise continuous activation function (threshold and signum function in neural network)
9. Program to realize gates using McCulloh Pitt model in MATLAB
10. Program to implement XOR gate using McCulloh-Pitts neuron
11. Program to create Perceptron using commands
12. Program for creating a Back Propagation Feed-forward neural network
13. Program to design a Hopfield Network which stores 4 vectors
14. Program to illustrate how the perception learning rule works for non-linearly separable problems
15. Program to illustrate Linearly non-separable vectors;

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1:** Remembering the concept of MATLAB and its operations.
CO2: Understand supervised and unsupervised learning concepts
CO3: Able to apply for cognitive tasks and processing of sensorial data such as vision, image- and speech recognition, control, robotics, expert systems
CO4: Design single and multi-layer feed-forward neural networks
CO5: understand training of recurrent Hopfield networks and associative memory concepts.
CO6: Ability to create Back Propagation Feed-forward neural network

SMRA2602	ROBOT PROGRAMMING LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To implement basic functions like MOVES, MOVE J Commands in Industrial Robot.
- To understand the different modes of operation of Industrial robot.
- To implement DELAY, SIGNAL Commands in robot programming
- To get familiarized on SUBROUTINES in Robot Programming.
- To implement Advanced commands and Gripper functions in Robot.

LIST OF EXPERIMENTS

1. Study of Robot coordinates and Joints in ABB IRB1520 Industrial Robot
2. Program the Robot for moving Major Axis
3. Program the Robot for moving Minor Axis
4. Program the Robot to draw Square
5. Program the Robot to draw Letter A and L
6. Program the Robot using MOVE L , MOVE J and MOVES.
7. Program the Robot for Simple Pick and Place Operation
8. Program the Robot for Multiple movements in AUTOMATIC MODE.
9. Program the Robot using MOVE L and MOVE C commands
10. Program the Robot to Parabola, Hyperbola and Ellipse.
11. Program the Robot using WAIT, SIGNAL commands

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1:** Remembering the robot coordinates, basic joint movements.
- CO2:** Understand basic concepts about MOVE L, MOVE S and MOVE J Commands
- CO3:** Able to apply and implement various programming functions to perform Square / Rectangle using gripper.
- CO4:** Ability to analyze the commands suitable for drawing Parabola and Hyperbola using Gripper
- CO5:** Compare and contrast different programming instructions
- CO6:** Design robot program for Pick and Place application.

SMEB1104	ENGINEERING GRAPHICS USING CAD	L	T	P	EL	Credits	Total Marks
		1	0	4	0	3	100

COURSE OBJECTIVES

- To know the basics of Engineering Graphics and make the student to possess the efficient drafting skill.
- To make the students to understand the importance of sectioning and concept of development.
- To learn about the orthographic and pictorial projections.
- Identify engineering graphics. Draw objects like points, lines, planes, and solids in perspective & orthographic projections

UNIT 1 DRAWING STANDARDS AND CONSTRUCTION OF BASIC SHAPES 9 Hrs.

Drawing standards: BIS – Lettering - Two systems of dimensioning - Drawing tools. Construction of the basic shapes: Points – Lines – Circle –Circular arc - Polygons – Ellipse – Parabola - Hyperbola – Spline Curves. Introduction to CAD packages: Setting up a new drawing template - Drawing Commands - Modifying Commands - Formatting commands - Dimensioning styles – Texts - Basic Function keys -Shortcuts. Features and applications of CAD.

UNIT 2 PROJECTION OF POINTS AND LINES 9 Hrs.

Projections - Types of projections –projection of points – Change of position method - Sketching the orthographic projection of points lying in four quadrants using a CAD package - Orthographic projection of lines (First angle projection only) - Sketching the orthographic projection of lines using a CAD package (Projection of lines parallel to one plane and inclined to another).

UNIT 3 ORTHOGRAPHIC PROJECTION OF SOLIDS 9 Hrs.

Types of solids – Orthographic projection of simple solids like prisms, pyramids, cylinder and cone (Change of position method) – Sketching of the front view and top view of solids in simple vertical position or the inclined position (inclined to one plane and perpendicular to another plane) using a CAD package.

UNIT 4 SECTION OF SOLIDS 9 Hrs.

Types of sectional views - Hatching - Section plane perpendicular to one plane and parallel to other plane– Sketching of the front view, top view and true shape of the solids with cutting plane parallel to one plane or inclined to one plane and perpendicular to another using a CAD package.

UNIT 5 DEVELOPMENT OF SURFACES AND ORTHOGRAPHIC PROJECTION 9 Hrs.

Need for development of surfaces - Types of development of surfaces - Development of pentagonal and hexagonal prisms - Development of cylinders - Development of pentagonal and hexagonal pyramids - Development of cones - Sketching of the development drawings of surfaces of solids in simple vertical position with or without sectioning using a CAD package.

Orthographic Projection- Drawing front view, top view and side view of objects from the given pictorial views using CAD package.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Identify the national standards related to the Engineering drawing based on BIS and construct conic sections and polygons.

CO2 - Draw the projections of points, lines.

CO3 - Draw projection of solid objects like prisms, cylinders, pyramids and cones used in various engineering objects.

CO4 - Draw orthographic section of solids and improve the visualization skill to develop New products.

CO5 - Draw the development of surfaces and its applications in manufacturing industry.

CO6 - Draw the 2D and 3D surfaces of engineering components using modeling software.

TEXT / REFERENCE BOOKS

1. Venugopal, K. and Prabhu Raja, V., Engineering Drawing and Graphics + AutoCAD, New Age International, 2021.
2. Trymbaka Murthy, S., Computer Aided Engineering Drawing, I.K. International Publishing House, 2017.
3. SP 46: Engineering Drawing Practice for schools and colleges, Bureau of Indian Standards.
4. AutoCAD – 2D CAD Reference Guide
5. Luzzader, Warren J., Duff John M., Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Prentice Hall of India Pvt. Ltd., 2016.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A : 10 Questions of 2 marks each-No choice

20 Marks

PART B : 2 Questions from each unit with internal choice, each carrying 16 marks

80 Marks

SMRB1102	FUNDAMENTALS OF ROBOTICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand the concepts of robotics and automation.
- To learn the basic configurations and performance of robot.
- To familiarize with the sensors, drive system, and control systems of a robot.
- To design a robot work cell for an industrial application.
- To understand the various applications of robots, justification, implementation and safety of robot.
- To write programming for various robotic application.

UNIT1 BASICS OF ROBOTICS

9 Hrs.

Introduction - Anatomy of Robot - Laws of robotics - Links and Joints of robot - Robot wrist - Configurations of robot - work volume - Spatial resolution - Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity-Drive Systems of Robot - Control system of Robot - Types of robot control - Robot motions Rotary to rotary motion, Rotary to linear motion, Harmonics drives.

UNIT 2 ROBOT SENSORS AND END EFFECTORS

9 Hrs.

Robotic sensors and actuators - Robot actuation and feedback components - Power transmission system – Robot joint control design - Robot End effectors Types of End effectors - Requirements and challenges of end effectors- Mechanical gripper- types of gripper mechanism - gripper force analysis – other types of gripper - special purpose grippers - Tools – Degrees of Freedom - Selection and design of Grippers.

UNIT 3 ROBOT KINEMATICS

9 Hrs.

Robot kinematics: Introduction - Position representation - 2 DOF Arm in 2D - 3 DOF Arm in 2D - 4 DOF Arm in 3D - rigid motion & homogeneous transformation forward & inverse kinematics - trajectory planning
- Wrist Orientation - Manipulator path control - Robot Dynamics: Robot Arm dynamics - configuration of a robot controller.

UNIT 4 WORK CELL DESIGN AND MACHINE VISION SYSTEM

9 Hrs.

Robot work cell design - Work cell types – Work cell Control - Factors to be considered for work cell design - Interlocks - Machine vision: - Sensing and Digitizing - Imaging Devices - Lighting Techniques - AD Converter - Image Processing - Data reduction - Segmentation - Thresholding - Region Growing- Edge Detection - Feature extraction - Object recognition - Applications Inspection - Identification - Visual servicing and navigation - Training the vision.

UNIT 5 ROBOT PROGRAMMING METHODS

9 Hrs.

Robot programming Methods - Methods of Defining Position - Motion Interpolation - Commands - Branching - Robot Languages Classification of robot language - Computer control and robot software - Val system and Languages - Application of robots - Process Applications - Material Loading and Unloading - Material handling - spot and continuous arc welding & spray painting -Robots for Assembly and Inspection

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

- CO1** - Understand the basics of robotics and to choose the appropriate type of drive and sensor system
- CO2** - To select the appropriate type of tools and grippers for various applications
- CO3** - To design a robotic arm and to bring a controlled movement in the end effectors
- CO4** - Understand the concept of Computer vision system and to develop a machine vision system for inspection
- CO5** - Ability to design robot work cell and develop robots for real life situational problems and think creatively for solutions
- CO6** - Ability to write various robot programs for various applications

TEXT / REFERENCE BOOKS

1. Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey , Ashish Dutta, Industrial Robotics - Technology, Programming and Applications McGraw Hill (SIE) | 2nd Edition 2012
2. John J. Craig, Introduction to Robotics: Mechanics and Control, third edition, Pearson Prentice Hall 2004
3. Harry H. Poole, Fundamentals of Robotics Engineering Van Nostrand Reinhold, Springer 2012
4. Frank L. Lewis, Darren M. Dawson, Chaouki T. Abdallah, Robot Manipulator Control Theory and Practice Second Edition, Revised and Expanded 2004
5. R.D. Klafter, T.A. Chmielewski and M. Negin, Robotic Engineering—An Integrated Approach, Prentice Hall of India, New Delhi, 1994.
6. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis ‘, Oxford University Press, Sixth impression, 2010.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A : 10 Questions of 2 marks each-No choice

20 Marks PART

B : 2 Questions from each unit with internal choice, each carrying 16 marks

80 Marks